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Device for sucking in and compressing at least one gas in a fuel cell system

The invention relates to a device for sucking in and compressing at least one gas in a fuel cell system which has a fuel cell to which gaseous fuel and an oxidizing gas are supplied.

A drive unit in a vehicle which has an electric driving motor, a fuel cell, a fuel tank, a water store, an evaporator and a reformer is known. The fuel tank contains methanol which, with water from the water store, is converted into the gaseous state in the evaporator and is then passed to the reformer, in which substantially hydrogen, carbon dioxide and carbon monoxide are formed when heat is supplied by means of a catalytic burner. The carbon monoxide can be oxidized using an oxidizing agent. The hydrogen-containing fuel gas from the reformer is fed by means of a compressor to the fuel cell, which comprises a fuel cell stack in which a large number of individual fuel cell modules are integrated. Air is fed to the fuel cell by means of a further compressor. In the fuel cell, electrical energy for the electric driving motor is generated from the hydrogen and the oxygen of the air (DE 44 12 450 A1).

To operate, a fuel cell requires sufficiently purified gas and/or a gas mixture with respect to the fuel gas and the oxidizing gas, which is in many cases air. This means that impurities in the gases have to be eliminated. Examples of impurities of this type, which damage the fuel cell system, may include particles, aerosols or polluting gases. Filters connected upstream of the compressors are used for the gas purification.

For compression it is possible to use centrifugal compressors, which in operation generate high-frequency noise, which is unpleasant. To reduce environmental pollution, this noise has to be muffled. It is known to arrange deep-tuned Helmholtz resonators in exhaust mufflers of motor vehicles. Since Helmholtz resonators for muffling noise generally comprise a plurality of cylindrical chambers connected to one another by tubes, they increase the overall volume of a gas-routing section. In particular in mobile devices, it is desirable to minimize the space taken up by gas-routing systems.

There is a known sound-muffling tube for carrying gases in which sound reflectors which reduce the passage cross section are arranged at intervals in the axial direction of the tube. The reflectors are formed by a corrugated tube wall, which in addition to the corrugation also includes elements which disrupt the propagation of sound (DE 35 05 401 A1).

In another known device for reducing resonance effects in pipelines through which gases flow, the gas flow is distributed between in each case two identical, substantially parallel tubes, at least one of which is provided with a perforation over which a covering hood is fitted (DE 94 00 428 U1).

Finally, a porous muffling hose for muffling intake noise in internal combustion engines is known (DE 196 35 799 A1). The muffling hose is formed from a roll of a flat mesh material of weldable plastic filaments which consist of a single material. Since the muffling hose is longitudinally elastic, it does not transmit any longitudinal vibrations in the intake section of the corresponding internal combustion engine.

The invention is based on the problem of providing a device for sucking in and compressing at least one gas in a fuel cell system in which the structure-borne sound originating from the respective compressor is muffled in a simple and space-saving way.

The problem is solved according to the invention, in a device for sucking in and compressing at least one gas in a fuel cell system which has a fuel cell to which gaseous fuel and an oxidizing gas are supplied, by virtue of the fact that a compressor for the gas is connected at its entry or gas inlet to a gas filter system via an elastic, sealed gas-routing passage made from textile material. In the device according to the invention, the sound waves emanating from the compressor when the latter is operating are muffled both by the elastic gas-routing passage or hose and by the gas filter system. The latter prevents sound waves which still arrive, for example, at the filter-side end of the gas-routing passage from being able to pass to the outside without being impeded.

In particular, the gas-routing passage includes fibers which are sealed off so as to prevent the penetration of gases from the space outside the gas-routing passage by means of an elastic coating. The coating may consist of a plastic, e.g. an elastomer, or of a metal.

In a preferred refinement, a gas-routing passage formed from porous, textile material is provided upstream of the gas filter system and connected to the gas inlet of the gas filter system. In this device, which constitutes an independent inventive configuration, the gas which is sucked in is pre-filtered. Furthermore, the sound waves, which have already been greatly muffled by the elastic gas-routing passage between compressor and gas filter system and by the latter, are

muffled still further, so as to achieve a particularly good reduction in noise. Moreover, the porous gas-routing passage upstream of the gas filter retains particles in the gas which is sucked in, so that they cannot enter the filter system.

It is expedient for the textile material of the porous gas filter passage to be coated with at least one active substance which is ready to react with respect to at least one gas. It is in this way possible to reduce the concentration of at least one polluting gas which is contained in the gas that is sucked in and is undesirable for operation of the fuel cell even upstream of the filter system.

In the text which follows, the invention is described in more detail on the basis of an exemplary embodiment illustrated in a drawing, from which further details, features and advantages will emerge.

The drawing diagrammatically depicts a device for sucking in and compressing at least one gas in a fuel cell system.

A fuel cell system 1, which in a manner known per se includes a fuel cell 2, for example of the PEM type, and further components which are not shown in the drawing, such as a fuel tank, a water store, an evaporator and a reformer, also has at least one device 3 for sucking in and compressing a gas. This gas may, for example, be air, the oxygen in which is the oxidizing gas which reacts with the gaseous fuel in the fuel cell 2 to generate electrical energy. Gaseous fuel contains, for example, hydrogen.

The device 3 includes a compressor 4 which sucks in and compresses the air. The compressed air passes, via passages which are not shown in more detail, to the

fuel cell 2. The compressor 4 used is, for example, a centrifugal compressor which is driven by an electric motor (not shown).

Fuel cell systems are also used in mobile equipment, such as motor vehicles, on account of their relatively high efficiency and low emission of pollutants. Small component dimensions and low weights are important factors in such equipment. On account of the small dimensions with a large delivery line, the compressor 4 is designed for high rotational speeds. At high rotational speeds, the compressor 4 generates disruptive noise composed of a plurality of frequency components.

The device 3 also includes a filter system 5 which is used to purify the gas sucked in by the compressor 4. The filter system 5 may comprise more than one section, for example two sections 6, 7. In section 6, for example, the gas which has been sucked in has particles, such as dust and particulates, removed from it, i.e. mechanical substances are cleaned out. In section 7, which is connected downstream of section 6, by way of example, pollutant gases which have an adverse effect on operation of the fuel cell are removed.

The high-frequency noise emanating from the compressor 4 is to be muffled using space-saving means in as simple a way as possible. For this purpose, the filter system 5 is connected to the gas inlet of the compressor 4 by an elastic, sealed gas-routing passage 8 made from textile material. The gas-routing passage 8 is in particular a hose formed from textile fibers or filaments, e.g. in the form of a woven fabric, and has a coating which prevents the penetration of gases from the space outside the gas-routing passage 8. It is therefore impossible for any further impurities to

enter the gas which has been sucked in by the compressor 4 downstream of the filter system 5. The textile materials of the gas-routing passage 8 may be coated with plastics or elastomers or metals. The coating may be applied to the inside and/or outside of the gas-routing passage. By virtue of its structure, the gas-routing passage 8 absorbs sound energy. Therefore, only some of the sound energy originating from the compressor reaches the gas filter system 5. The gas filter 5 further muffles sound energy.

On that side of the gas filter system 5 which is remote from the compressor 4, i.e. on its gas inlet side, the gas filter system 5 is connected to a porous, flexible gas-routing passage 9 which is composed of textile material. The gas-routing passage 9, which, in particular as a porous hose, consists of plastic or natural fibers or filaments which can be worked into a fabric additionally muffles any sound energy which may still emerge from the filter system 5. The intake and compression device 3 illustrated in the drawing therefore has particularly good sound-muffling properties.

Furthermore, the gas-routing passage 9 effects pre-filtering of the gas which has been sucked in, i.e. particles, such as dust, are retained even at this stage, which means that they can no longer enter the filter system 5. The porosity of the gas-routing passage 9 can be adapted to the size of particles which may be present in the gas which is sucked in.

Furthermore, it is advantageous if the surface of the gas-routing passage 9 is provided with an active substance which reacts with certain gases which are undesirable for operation of the fuel cell 2 and, for example, adsorbs them. It is in this way possible to reduce the concentration of gases of this type even

upstream of the filter system 5. The pre-filtering of the gas which is sucked in makes it possible to reduce the outlay on the gas filter system 5, i.e. less space is needed for the gas filter system 5.